Army Model & Simulation Office (AMSO) Benefits Initiative (BI)

...helping leaders make better decisions.

by

Mr. William H. Dunn

Army Model and Simulation Office

Chip Cobb, Ross Dickinson

A|B Technologies, Inc.

for

Summer Computer Simulation Conference, Chicago

AMSO BI
Purpose

- To **describe** the Benefits Initiative concept.
- To **demonstrate the utility** of the Benefits Initiative process through a proof of principle.

AMSO BI
Agenda

- Background
- Phase I - Concept, Methodology
- Phase II - Proof of Principle

AMSO BI
Examples of Past Work

- AMSAA's "benefit" Report dated March 1997.
- DMSO's "M&S Benefits Task Force" Report dated December 1995.
- DTSEE "Effectiveness of M&S in Acquisition" dated October 1995.

AMSO BI
Why is the BI Important?

- A standardized way to quantify M&S benefit is needed to fully justify the expense of M&S.
- The Army must be capable of responding to effectiveness and benefit questions.
- In order to facilitate M&S decisions, a benefits determining process helps make comparisons between alternatives.

AMSO BI

What are some uses of the Benefits Initiative?

Multiple HQDA management processes dealing with:

- Vision, strategy and policy evaluation,
  - How significant is M&S to training the Digital force?
- Review, integrate, approve, and prioritize requirements,
  - What should we use? Where should we invest? What has priority?
- Fund activities,
  - What programs could be extended or reduced?
- Reconcile investments,
  - What programs should be eliminated?
- Manage, educate and advocate.
  - Promote understanding through common language and processes.

AMSO BI
BI Charter

The Army BI Charter

"…I have directed AMSO to coordinate the Army's efforts to develop and implement a definable process by which quantitative and qualitative M&S benefits are captured enabling our better understanding, justification, and use of M&S across the Army.

"…AMSO will develop a comprehensive M&S benefits methodology (or methodologies) which will provide a factual basis to answer M&S benefits questions.

MG LaPorte, ADCSOPS, 23 Jan 98

Phase I

- Objectives Hierarchy
- Metrics
- Techniques to compute benefit

Phase II

- Proof of Principle

Phase III

- Implementation

AMSO BI
Phase I Milestones

Jan 98 Phase I Start

- Research & coordinate with domain SME to develop an approach with applicability across all Army Domains.
- **"Objective Hierarchy"** -- a "strategy to tasks" tree that captures relationships between tasks & objectives.
- **"Metrics Space"** -- a 20 cell matrix that categorizes the full range of metrics used to measure the uses and benefits of M&S.
  - Populate the Metric Space with metrics.
- Glossary of terms that are commonly used, but not generally understood

Sep 98 Phase I Complete

Dec 98 Final Report

AMSO BI

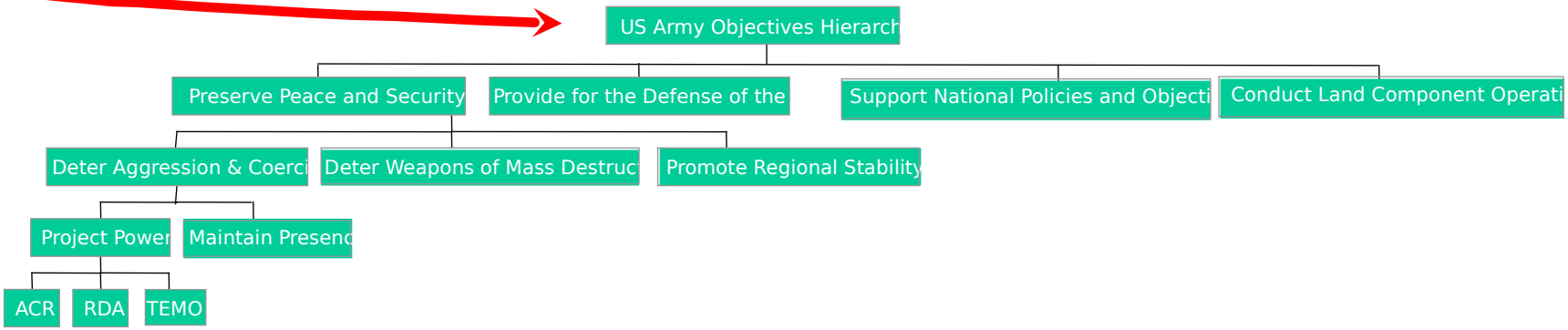
The Objectives Hierarchy Is…

…An “objectives tree” that decomposes army/domain high-level objectives into lower-level tasks of increasingly more detail.

…Enables “cross-domain” benefit analysis

The U.S. Army Mission:

- Preserve the peace and security, and provide for the defense of the United States, the Territories, Commonwealths, and Possessions, and any areas occupied by the United States
- Support national policies
- Implement national objectives
- Overcome any nations responsible for aggressive acts that imperil the peace and security of the United States



AMSO BI

The Metric Space Is…

…A two dimensional array for selecting, cataloging and retrieving metrics.

Four basic categories of Benefit

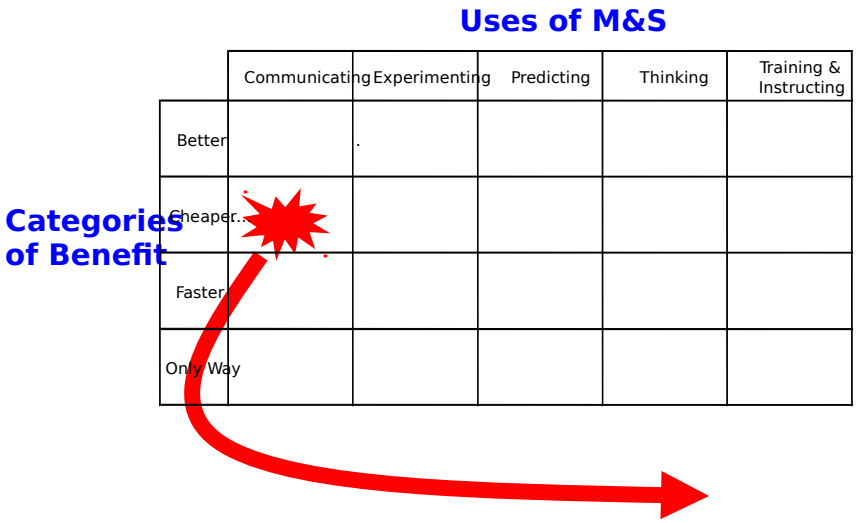
Five basic "uses of M&S"

Uses of M&S

Categories of Benefit

	Communicating	Experimenting	Predicting	Thinking	Training & Instructing
Better					
Cheaper					
Faster					
Only Way					

AMSO BI
Example: Metrics in the Metric Space



CHEAPER: The total cost of the product or process is reduced through the application of M&S.

AID TO COMMUNICATING: The use of M&S in helping to visualize concepts, make ideas more comprehensible, illustrate findings, or demonstrate important cause and effect relationships.

Cost savings of using new methods

Cost savings associated with completing task early

Number of dollars saved by using computer models rather than a physical prototype

Money/effort saved in programs that are completed/terminated early

Reduced labor costs due to fewer meetings and data submittals

Reduced demand on management, facilities, and personnel resources (i.e. less time, number, amount, etc.)

AMSO BI

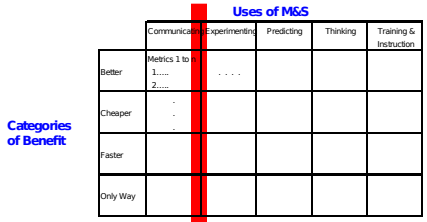
How do we get benefit?(Executive Overview)

With these tools:

Objectives Hierarchy

The Army's mission is defined in a Hierarchy of Objectives (OH). The contribution of M&S to supporting mission accomplishment is assigned to that location in the OH where M&S is used.

Metric Space



The Metric Space is an organized repository of Metrics. Metrics measure the quantitative outputs and characteristics of the M&S or M&S alternatives, allowing us to determine the "benefit" derived from the output/characteristic.

Value Assessment

Measure the "value" different M&S users assign to the "benefit" obtained from the M&S.

We derive:

M&S Benefit

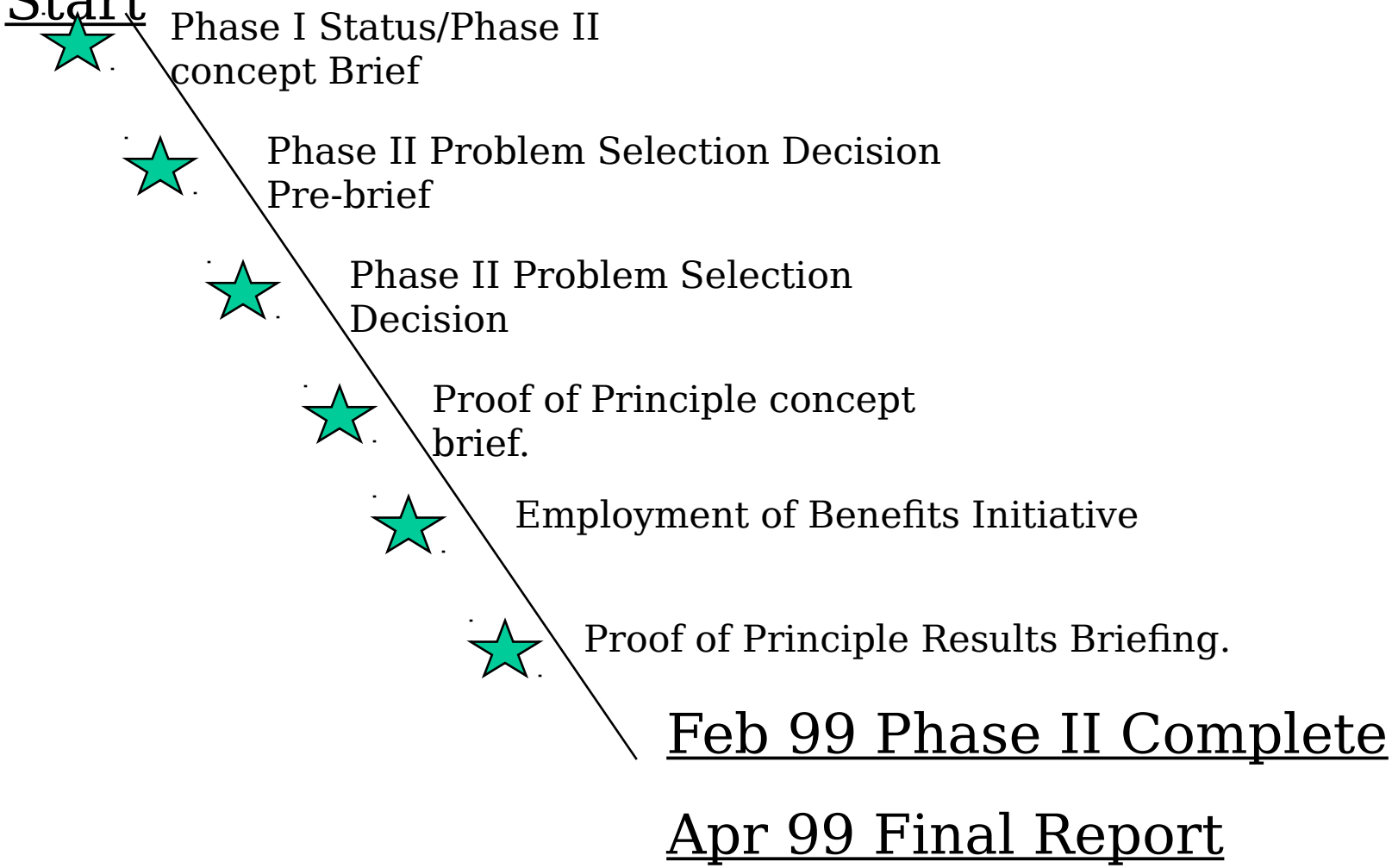
"Value" is assigned to applicable nodes at the lowest level of the OH. "Importance" is assigned to the legs at all levels of the OH. Aggregate "benefit" is assessed up the OH.

AMSO BI
Purpose of Phase II

- To **demonstrate the utility** of the Benefits Initiative through a proof of principle.
  - by employing products and techniques developed in Phase I
  - by executing in a time and dollar constrained environment

- To **provide insight** into a current problem which will be used in a “real world” decision.

AMSO BI
Phase II Milestones



AMSO BI
Refined Problem Statement

Recommend a simulation/stimulation package to support the Joint Contingency Force Advanced Warfighting Experiment (JCF-AWE).

AMSO BI
Provided Alternatives

A. **"JCATS":** White Cell to drive SOF-HUMINT, Intel Systems, Pol-Mil, SASO and CSS inputs; **JCATS** to drive Joint Air and Naval Forces, USMC Amphibious Operations, the Strike Force, SOF, and Intel Functions.

B. **"JSAF":** White Cell to drive SOF-Humint, Intel Systems, Pol-Mil, SASO and CSS inputs; **JSAF** to drive Joint Air and Naval Forces, USMC Amphibious Operations, the Strike Force, Heavy Forces, SOF, and Intel functions.

C. **"JTC+":** **Spectrum** to drive SOF-Humint, Intel Systems, Pol-Mil, and SASO inputs; **JTC** to drive the Strike Force, Heavy Forces, Joint Air and Naval Forces, USMC Amphibious Operations, SOF, Intel and CSS functions.

D. **"JTC":** White Cell to drive SOF-HUMINT, Intel Systems, Pol-Mil, and SASO inputs; **JTC** to drive the Strike Force, Heavy Forces, Joint Air and Naval Forces, USMC Amphibious Operations, SOF, Intel and CSS functions.

All options include:

- JRTC live environment
- Entity Based Model for 1 INF TF (TF3)
- Live MOUT ACTD for USMC company

AMSO BI Approach

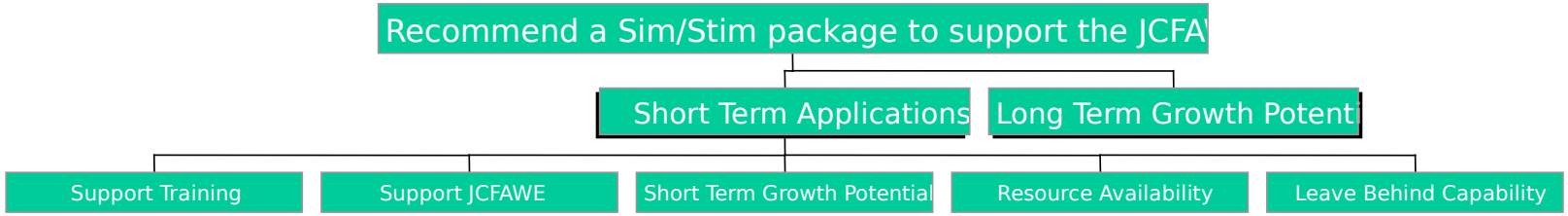
- Cost benefit
  - Each alternative's benefit measured against a pre-determined set of criteria. Alternatives provided by NSC.
  - Cost benefit calculated by dividing the benefit, for each alternative, by its respective implementation cost. Cost estimates provided by NSC.

- Analytic Hierarchy Process (AHP)
  - Develop and "compare"criteria / Objectives Hierarchy
  - Develop benefit ratings for each alternative

AMSO BI
Steps to Implement the Approach

- **Preparation and General Research**
  - Draft Problem Statement
  - Evaluate alternatives
  - Evaluate decision criteria
- **Group Assessment Meeting 1: Structure and Criteria**
  - Finalize the Problem Statement, Decision Criteria, and Alternatives
  - Construct and weight Objectives Hierarchy
- **Specific Research and Impact Analysis**
  - Study relative impact (or performance) of alternatives on each of the relevant criteria (apply metrics)
- **Group Assessment Meeting 2: Assessment of Alternatives**
  - Debate the relative impact or performance of alternatives on the criteria
  - Weight alternatives
- **Analysis Tasks**
  - Analyze participant inputs
  - Conduct Sensitivity Analysis
  - Summarize Findings and Conclusions
  - Identify recommended option and why
- **Group Assessment Meeting 3: Findings, Conclusions, and Recommendations**
- **Report**

AMSO BI
Objectives Hierarchy (first three levels)

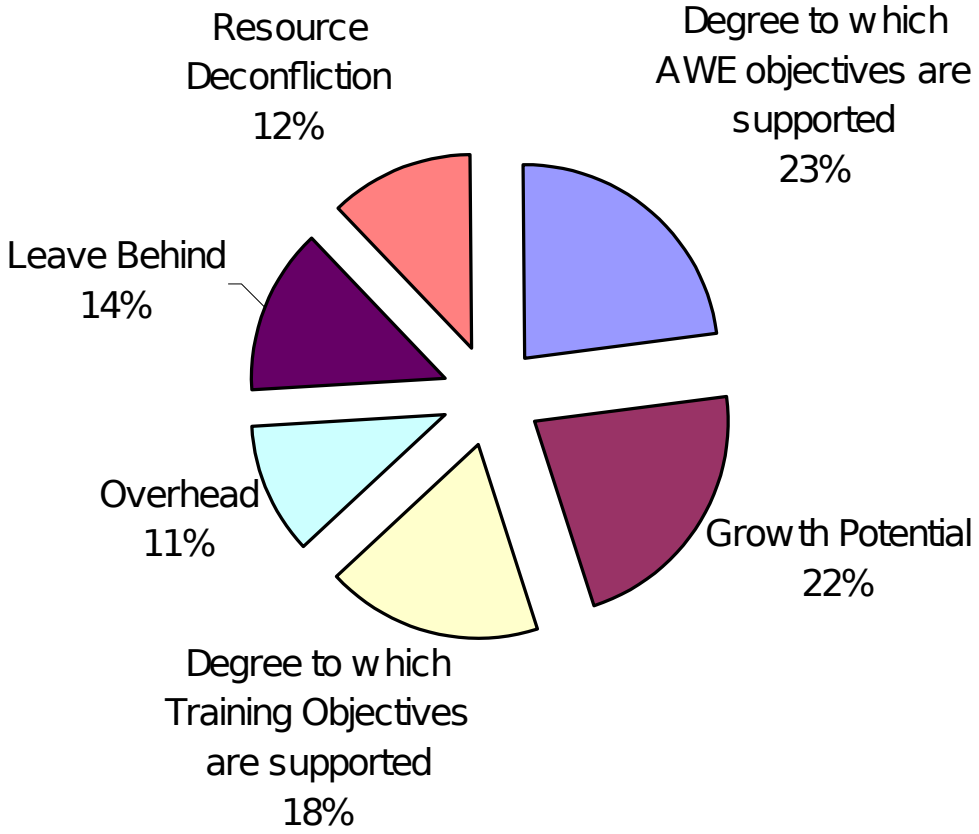


- Objectives Hierarchy structured and weighted by group consensus of Subject Matter Experts (five SME).

- 7 levels with 62 criteria at the bottom nodes.

- Structure of the Objectives Hierarchy shaped by purpose of experiment and planning considerations.

AMSO BI
Major Selection Criteria



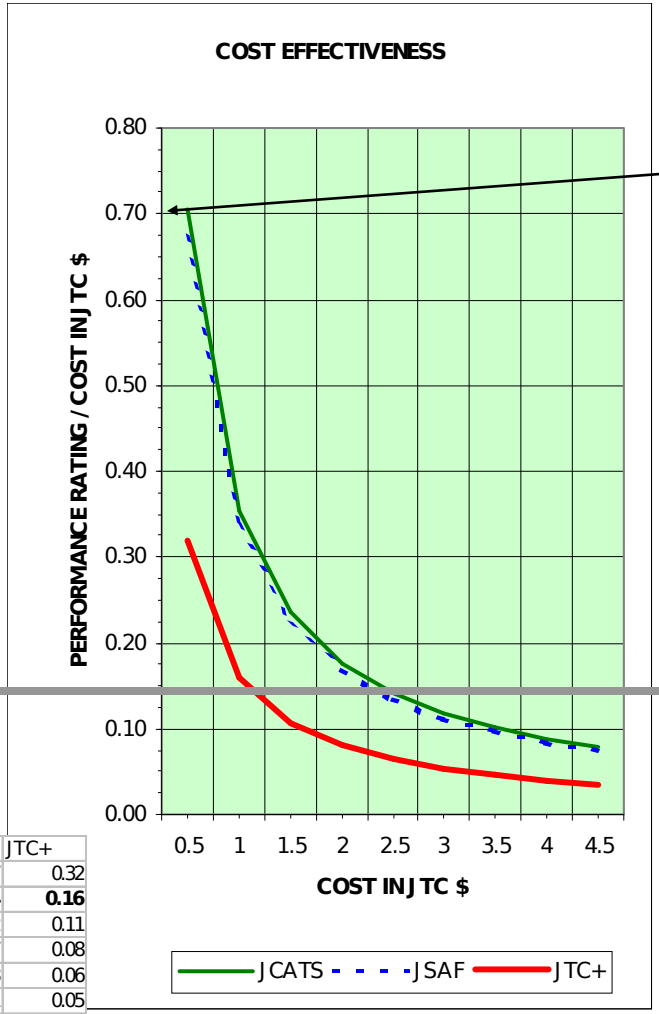
Cost is treated as an Independent Variable

AMSO BI
Overall Benefit (Higher is Better)

CRITERIA	JCATS	JSAF	JTC+	JTC	CONTRIBUTION
AWE OBJECTIVES	6.5	6.6	5.0	5.0	23%
GROWTH POTENTIAL	7.9	10.7	2.0	1.8	22%
TRAINING OBJECTIVES	4.0	3.1	5.8	5.0	18%
LEAVE BEHIND	7.2	4.0	1.4	1.4	14%
RESOURCE AVAILABILITY	5.4	5.4	0.6	0.6	12%
OVERHEAD	4.2	3.8	1.2	1.3	11%
PERFORMANCE RATING	**35.3**	**33.6**	**16.0**	**15.2**	100%

AMSO BI
Cost Effectiveness

The Baseline is JTC and provides . 15 units of benefit for 1 unit of cost



	JCATS	JSAF	JTC+
0.5	0.71	0.67	0.32
1	**0.35**	**0.34**	**0.16**
1.5	0.24	0.22	0.11
2	0.177	0.17	0.08
2.5	0.141	0.13	0.06
3	0.12	0.11	0.05
3.5	0.10	0.10	0.05
4	0.09	0.08	0.04
4.5	0.08	0.07	0.04

- **Cost is an Independent Variable**
- **X axis is cost in JTC $**
- **Y axis is cost effectiveness (e.g. JCATS benefit of 35 divided by .5 JTC $ equals cost benefit of .70)**

OBSERVATIONS:

- JSAF, JCATS, and JTC+ are preferred when their cost effectiveness curves lie above the baseline. JTC is preferred in regions where these curves fall below the baseline
- We prefer JTC+ when its cost in JTC $ is less than 1.05
- We prefer JCATS over all others when its cost in JTC $ is less than 2.32
- We prefer JSAF over JCATS when JSAF cost is marginally less (about 4% less) than JCATS

NSC Cost Estimates (in JTC $)

JTC = 1

JTC w/Spectrum < 1.1

JCATS = 2.5

JSAF = 4

AMSO BI
Proof Of Principle Recommendation

- If budget is paramount, then use JTC.
- If benefit is paramount and you can absorb the cost, then use JCATS.
- If long term growth potential is paramount, you can absorb the cost, and risk is acceptable, then use JSAF.

AMSO BI
Benefits Initiative Feedback

- Provides a structured process to get insight, to justify or to debate (Phase II---NSC.).
- “Levels the playing field” and provides standardization. Should be adopted by the Army and possibly DoD (Phase II---NSC.).
- Only on-going effort by a Service. (Phase II---DoD Training Functional Working Group).

Army Modeling & Simulation Office
Benefits Initiative (BI)

…helping leaders make better decisions.

http://www.amso.army.mil/

AMSO BI
AWE Considerations

Scope

Before/During/After

Joint/C4ISR

Leave Behind

- The JCFAWE focuses on the JTF (corps and below) with JRTC at Ft Polk.
- NSC is tasked to lead the simulation/stimulation effort:
  - train-up support to participating units
  - support the AWE event
  - provide follow-on sustainment training for any residuals.
- The simulation/stimulation package must provide joint operational and tactical context for participating units and to stimulate all their C4ISR.
- In the selection process, consider each simulation/ stimulation package's potential to mature into a system that satisfies current and emerging C4ISR training requirements.

AMSO BI
Metric Space

- Measures of Effectiveness not used to explicitly measure the alternatives against the criteria.
- The Metric Space provided a backdrop for discussion

The ability to make relative judgements based upon experience is a strength of AHP

AMSO BI Metrics

			USES		
BENEFITS	Communicating	Experimenting	Predicting	Thinking	Training & Instructing
Better	*	*	*	*	*
Cheaper		*			*
Faster	*	*			*
Only Way	*	*			*

AMSO BI
Summary of Findings

- The older systems (JTC and JTC w/ SPECTRUM) are expected to provide better training for Corps/JTF & Division Staffs.
- JTC is preferred over JTC+ if people/equipment availability in September is an issue (UFL in August 2000).
- The newer systems (JCATS and JSAF) are preferred when overhead, interfaces, and integration with C4ISR are issues.
- JCATS is preferred over JSAF for the near term but JSAF has significantly greater long term potential.
  - JCATS and JSAF are essentially equal over all

AMSO BI
Sensitivity Analysis

- JCATS and JSAF preference ratings are sensitive to value placed on short term needs versus long term growth potential:
  - An 8% shift favoring the long term results in equivalent performance ratings
  - Cost remains the overriding factor

- JCATS and JTC have roughly equivalent cost effectiveness; a 10% reduction in JCATS implementation cost makes them equivalent

- JSAF requires a 40% reduction in implementation cost to achieve equivalent cost effectiveness with JTC